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## Permit Monitoring Services

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## Abstract:

An underwater survey program to measure bark debris accumulation at six Log Transfer Facilities (LTF) located on Revillagigedo and Prince of Wales islands, southeast Alaska, was undertaken in February, 1995. The intent of the survey is to satisfy the bark deposition monitoring program required by the Environmental Protection Agency (EPA) permit to operate the facility. As stated in paragraph C6 of the LTF Siting, Construction, Operation and Monitoring/Reporting Guidelines, 1985 (1), 100% bark coverage exceeding both one acre in size and a thickness greater than 10 centimeters (cm) at any point are the criteria to initiate possible cleanup action, which provides the guidelines for the survey.

## Method:

The survey technique described follows the method used by government agencies when they evaluate a site for use as an LTF. This standardized technique provides a better comparison with baseline data collected prior to LTF use and focuses the survey on the log bundle entry area while providing coverage of adjacent grounds.

A permanent reference point location is selected, ideally in the center of the bundle entry structure/ramp and located measurably close to an essentially permanent structure/landmark so that the reference point can be relocated in the future for continuation of the monitoring program. Depth of the reference point is positioned as close to 0 feet Mean Low Low Water (MLLW) as possible using the NOAA Tide Tables (2) and the nearest reference station for tide height correction calculations. Using the outer horizontal face of the entry structure as a reference plane (center of a drive down ramp/low angle slide), magnetic compass headings for five transects in 30 degree intervals are selected with the permanent reference point as the origin for each of the five transects. The middle transect is perpendicular (parallel to ramp/slide axis) to the face of the entry structure.

Each transect is sampled at five meter intervals starting from the origin at the permanent reference point. Sample points continue to be established along a transect until a water depth of 60 feet MLLW is reached or the measured bark debris depth becomes insignificant. At each sample point several data are recorded by the diver: water depth, debris depth, percent coverage of debris (determined by randomly dropping the meter stick at the sample point and estimating amount of contact with debris), debris

composition and character, substrate type, general algal and animal species and condition, abiotic factors such as direction and strength of current (if present) and the presence of any notable manmade debris. Transects are labelled with their magnetic compass heading for identification purposes.

On a subsequent dive, 35mm photographs are taken of representative sample points to document substrate, bark debris and algal and animal life.

The field data was analyzed to meet the criteria of the contract. Without the extensive data necessary to calculate bark debris coverage area to a reasonable confidence level, areal extent was calculated with the outermost two transects as the boundaries of bark coverage. Debris surface area calculation was made by taking the triangle formed by two of the transects and using the transect with the most sample points (longest distance) as the base leg of a right triangle area calculation. The total square footage of the debris field area was a summation these four triangle areas. This figure was converted to acres as required by the guidelines.

To determine areal extent of substrate with at least some bark debris the percentage of sample points with some coverage was calculated and multiplied by the total sample area, then divided by the square footage of one acre to derive the areal extent in acres. The same procedure was used to determine areal extent for the area with 100 percent coverage and for area with debris depth ten centimeters or greater.

## Results:

### Site 1:

<u>Site:</u> Thorne Arm 6	
<u>Date Surveyed:</u> 2/12/95	<u>Total # of Sample Points:</u> 29
<u>Time of Sampling:</u> 1007	<u>Average Bark Depth:</u> 7.7 cm
<u>Sampler:</u> Sempert	<u>Calculated Survey Area:</u> 0.3 ac

Area with Cover	Area with 100% Cover	Area with Debris Depth >10 cm
0.3 acre	0.1 acre	0.1 acre

Bottom topography at this site is characterized by a short (only 30 to 40 feet wide), gently sloping shelf that comes to a vertical dropoff to depths greater than the guideline limitation on diving depths. Log bundles are loaded from shore on to a barge positioned directly against the vertical log bulkhead. The facility was not operational at survey time. Slight south to north current was present during the dives.

Most of the bark debris observed was located close to the bundle loading area in a narrow band on a bottom slope that is shallow enough for the debris to settle and not slide immediately off. Most of the shelf was relatively light in debris, probably due to a steep enough slope causing sluffing of debris. As an experiment, one sample was taken at the base of the vertical dropoff on an extension of transect 240, to observe debris accumulation in this unique topographical situation. At this point a bark depth of 36 cm was measured and was composed of the same material as on the upper shelf and appeared to be uniformly distributed on this 100 foot deep, short shelf before the next dropoff.

The debris consisted of what we classified as bark dust (particles from approximately four centimeters in size to fine, like sawdust) and splintered pieces of wood and bark, branches with needles still attached to sunken logs. Little manmade debris was observed, mainly cable and wire pieces.

The marine life community, typical of a rock substrate exposed to a moderate current, was healthy and diverse. The rich encrusting organism community on the vertical rock wall appears not to be affected by the small amount of fine bark debris that manages to catch on the organisms as it rains downward.

## Site 2:

<u>Site:</u> Traitors Cove 8	
<u>Date Surveyed:</u> 2/10/95	<u>Total # of Sample Points:</u> 79
<u>Time of Sampling:</u> 1508	<u>Average Bark Depth:</u> 5.7 cm
<u>Sampler:</u> Sempert	<u>Calculated Survey Area:</u> 1.9 ac

Area with Cover	Area with 100% Cover	Area with Debris Depth >10 cm
1.9 acre	0.7 acre	0.3 acre

Situated in a large bay in lower Traitors Cove with the alluvial plain of a creek influencing the area, the site has a slight slope from shore dropping steeply to become a

flat bay bottom of silt and mud. Method of bundle entry was a high angle slide from an A-frame with a moderate high tide necessary to float the bundles, the A-frame structure has been removed and the site was not active at the time of survey. No appreciable current was observed during the dives.

An old site with a large volume of wood transferred in the past, the distinction between old bark debris and natural sediment was difficult. The estimation of bark depth was hampered by lack of clear distinction between old debris and sediment. Some of the bark debris appeared recent and some was estimated to be quite old. Another bark debris identification problem is the apparently large volume of natural forest debris washed down from the creek watershed. The transects most affected by this latter problem are 150 and 180, which are directly in the path of the creek debris, but lighter debris such as leaves were present on all transects.

Bivalve siphons were observed on all transects up on the shallow flats. On the steep dropoff and on the bay bottom numerous Dungeness crabs were actively moving about. A few juvenile flatfish were observed out towards the end of the transects on the flats. And if any hard substrate was available organisms like tunicates and anemones would be attached.

Little manmade debris was observed in the area. Other than the usual scattered wire coils and boom chains, two inch and about six inch diameter pipelines were encountered.

### Site 3:

<u>Site:</u> Carroll Inlet 20	
<u>Date Surveyed:</u> 2/13/95	<u>Total # of Sample Points:</u> 38
<u>Time of Sampling:</u> 1046	<u>Average Bark Depth:</u> 10.0 cm
<u>Sampler:</u> Sempert	<u>Calculated Survey Area:</u> 0.5 ac

Area with Cover	Area with 100% Cover	Area with Debris Depth >10 cm
0.5 acre	0.3 acre	0.2 acre

Located in an area of steep slopes to deep water, most of the substrate is fill rocks and boulders from construction of the flat log transfer area. Transects 350 - 080 drop rather rapidly to beyond survey depth guidelines with some outcroppings of bedrock protruding

through the fill. Transect 110 crosses a shelf which is covered with a sandy substrate before dropping off steeply. The beginning of the log storage area is in this vicinity.

Most of the debris appears to be relatively recently deposited; no patches of white bacterial mats or accumulation of decay products around branches and logs were observed. Overall debris size is small and fairly uniform with the occasional branch or sunken log. Measurement of debris was difficult due to accumulation in crevices and pockets formed by the jumbled fill rocks. Except on transect 110 there is little flat surface for even settlement of debris particles.

Since its recent construction, the fill boulders have been densely colonized by a limited number of species of invertebrates. These organisms have found purchase primarily on the sides and nearly vertical surfaces of the rocks, any horizontal surface of a boulder has minor to measureable debris accumulation. Though this encrusting growth is very dense it appears to consist primarily of four different organisms; the Jingle shell (*Pododesmus cepio*), Serpulid tubeworms and two species of Tunicates. Along transect 110 in the sandy shelf area, numerous juvenile Sea pens (*Prilosarcus gurneyi*) were present despite the thin debris layer. Also present was a Sea pen predator, the nudibranch *Armina californica*, which differs in many ways from the other nudibranchs of the area. Several Moon snail (*Polinices* sp.) egg masses with their collarlike shape were also observed in this area.

Little manmade debris was observed except in the area of transect 110, above which is positioned a rigging float. Numerous wire coils have fallen off and are scattered about. In front of the bulkhead lays a massive steel I-beam like the two vertical ones on the face of the bulkhead.

#### Site 4:

<u>Site:</u> Davidson Inlet 8	
<u>Date Surveyed:</u> 2/26/95	<u>Total # of Sample Points:</u> 92
<u>Time of Sampling:</u> 1148	<u>Average Bark Depth:</u> 5.3 cm
<u>Sampler:</u> Sempert	<u>Calculated Survey Area:</u> 2.5 ac

Area with Cover	Area with 100% Cover	Area with Debris Depth >10 cm
2.5 acre	<u>2.0 acre</u>	<u>0.2 acre</u>

Situated at the head of a long, relatively narrow bay, the low angle slide is on the western shore and was not in use at survey time. Part of a standing boom system is still anchored in the center of the bay. A second low angle slide is approximately 300 feet to the northwest of the main slide. Little or no current was observed during the dives. Bottom composition is primarily silt or fine mud with some sand and gravel on the shallow shoreward slopes.

Bark debris size ranged from bark dust to large pieces or chunks, but most of the debris was fairly uniformly sized bark chips. Few to no branches or sunken logs were observed at this site. As a LTF with a long history of use and a silty bottom type, this site is very difficult to measure the actual debris depth. There is a pronounced surface layer of bark debris over very soft silt - if the diver digs his hand into the silt beneath the bark layer pieces of bark debris are still encountered but in a homogenous mixture with low bark density. If the measuring stick is pressed into the soft sediment a reading of ten times the depth of the stratified debris layer on top is derived without confirmation of having penetrated the debris zone.

As an experiment an acrylic coring tube was pressed into the bottom in several locations to hopefully be able to clearly see the actual debris layer. No conclusive results were achieved. It was very difficult to find a spot to get much penetration without something blocking the way. And when reasonable depth was reached the fine nature of the sediment tended to mix in the tube rather than stay intact.

Marine life was not present in abundance or superficially obvious because of activity. The Dungeness crabs present in previous surveys were not observed. Only one adult Sea cucumber and two small juveniles were observed when usually they are ubiquitous. Several mounds marking the dens of what are thought to be burrowing crustaceans were seen. No excavation pits resulting from the Sea star *Pycnopodia* digging after clams were observed along the transects. Scattered fronds of attached kelp were present as was recently turned silt from underneath the bark debris - an indicator of some sort of burrowing activity.

A few larger manmade debris objects were observed. Two large culvert sections, approximately four feet in diameter and twenty feet long were fairly close to the slide. Near transect 020 a jumbled pile of machinery lay where it fell.



## Site 5:

<u>Site:</u> Twelve Mile Arm 1	
<u>Date Surveyed:</u> 2/24/95	<u>Total # of Sample Points:</u> 43
<u>Time of Sampling:</u> 1257	<u>Average Bark Depth:</u> 8.1 cm
<u>Sampler:</u> Sempert	<u>Calculated Survey Area:</u> 0.6 ac

Area with Cover	Area with 100% Cover	Area with Debris Depth >10 cm
0.6 acre	0.3 acre	0.4 acre

A LTF that has been operated for a short while, this operation uses an A-frame and high angle slide to lower the log bundles into the water. The bottom is gravel to bedrock intertidally becoming a steep slope of sand, shell and silt with scattered ridges of bedrock protruding. The slope lessens and becomes a relatively flat bottom past the rock ridge at the limit of the diving depths. Log bundle storage begins directly out from the bulkhead and extends to the north.

Of the five large logs that make up the high angle slide portion of the bulkhead, the three on the north side have broken completely in two about three to ten feet off the bottom. It appears that the logs have become completely riddled by the boring action of Shipworms (probably *Bankia setacea*, a clam) and possibly the Gribble (*Limnoria lignorum*), a small isopod.

Bark accumulation was greatest near the slide and tending to the northwesterly transects, possible due to a dominant south to north tidal current. A few large branches with needles still attached as well as sunken logs were observed, but primarily the debris was composed of smaller bark chips and chunks. A very slight current was present during the dives and the cycle was nearing the end of an ebbing tide.

Marine life was present on all transects in varying numbers and species. On sample points with the greatest debris accumulation Sea cucumbers and their casts were common. A specie of aeolid nudibranch was also common and one large unidentified gastropod was observed actively moving about on the surface of the debris. Shrimp were present only on the deepest sample points. Where the debris layer thinned out a normal benthic community inhabiting a sand/shell and gravel substrate appeared to be present.

No prominent manmade debris was present except towards the end of transect 220 where numerous wire coils and boom chains had fallen from the boom boat tie-up area

above.

## Site 6:

<u>Site:</u> Ulloa Channel 4	
<u>Date Surveyed:</u> 2/22/95	<u>Total # of Sample Points:</u> 57
<u>Time Surveyed:</u> 1205	<u>Average Bark Depth:</u> 4.8 cm
<u>Sampler:</u> Sempert	<u>Calculated Survey Area:</u> 0.9 ac

Area with cover	Area with 100% Cover	Area with Debris Depth >10 cm
0.9 acre	0.3 acre	0.1 acre

This LTF's rock fill peninsula has been modified from a flat area with a bulkhead at the end to a low angle slide with steel rails on the sides of the drive down ramp. A steep slope of fill rock to a relatively flat, shallow bottom of sand, silt and shell characterizes the bottom topography. Little to no current was noticed during the dives.

Bark debris was composed mostly of bark chips and chunks on the slope and flats directly in front of the slide. With distance from the input area the debris generally became more uniform in size and smaller with some larger pieces interspersed. Some fresh branches and twigs were observed as well as the occasional sunken log.

A marine community with variability in structure was observed. The rock fill slopes to the east were essentially barren of encrusting life, while the fill rocks to the west have a rich community supporting higher trophic levels such as several species of Rockfish. Nearly all substrate and undisturbed bark debris was covered by a fine covering of what is thought to be filamentous diatoms. Coverage by macroalgae was low but higher in the transects to the south where the substrate has more rocks in it for attachment. A sunken log near the front base of the fill slope had approximately a half dozen small (carapace width of 3-4 inches) King crabs were clustered together on the underside of the butt end of the log. An unidentified specie of dorid nudibranch had set numerous white egg ribbon masses over a wide area in the vicinity of the eastern transects but very few of the nudibranchs were observed in that area. While over in the area of transect 145 the nudibranchs were clustered in groups of dozens on any available surface (ex: kelp blade, bark slab, old survey stake) but very few egg ribbons were visible.

Little manmade debris was observed other than the usual wire and cable. An unusual

observation was the criss crossing of the entire survey area by seemingly random trenches. Some of the trenches were three feet deep and six to eight feet wide and went farther than the 40-50 foot visibility, some were not quite as wide. These are thought to be created by the dragging about of boulder and bulldozer track anchors to reposition them in new stiff leg arrangements.

## Appendix

### A. References:

- 1) LTF Guidelines Technical Subcommittee. 1985. Log T11 Transfer Facility Siting, Construction, Operation, and Monitoring/Reporting Guidelines.
- 2) U.S. Department of Commerce, NOAA, NOS. West Coast of North and South America, Tide Tables 1995.

## **B. Permanent Reference Point Location:**

### **Site 1: Thorne Arm 6**

Centered on middle of bulkhead, spike in lower part of fourth log down. Reference point directly below on substrate approximately two feet out from bottom horizontal bulkhead log.

### **Site 2: Traitors Cove 8**

Centered on middle of bulkhead, spike in underside of second horizontal log down. Reference point at interface between large fill rock and substrate.

### **Site 3: Carroll Inlet 20**

Centered on bulkhead, spike in underside of second large horizontal log. Reference point directly below on fill gravel/rock at bottom bulkhead log.

### **Site 4: Davidson Inlet 8**

Centered on slide axis. Located on fill rock and gravel at a point even with the ends of the slide logs.

### **Site 5: Twelve Mile Arm 1**

Centered on bulkhead, spike in underside of top log between middle two slide logs. Reference point on the bottom at the end of the middle slide log.

### **Site 6: Ulloa Channel 4**

In line with the ramp centerline axis. Reference point located on fill gravel shelf approximately four feet beyond the end of the ramp.

## C. Transect Data:

### Site 1:

#### Transect Data

#### Thorne Arm 6

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
Ref Pt	3	<3	10
180/1	9	20	90
180/2	14	5	75
180/3	16	<3	25
180/4	19	<3	25
180/5	35	<3	10
180/6	54	<3	10
210/1	11	20	100
210/2	18	10	100
210/3	25	3	50
210/4	39	<3	10
210/5	56	<3	25
240/1	10	28	100
240/2	22	<3	75
240/3	38	<3	25
240/4	58	<3	10
270/1	12	13	100
270/2	19	3	75
270/3	35	3	25
270/4	49	<3	25
270/5	64	<3	10
300/1	9	15	100
300/2	15	13	100
300/3	19	33	100
300/4	22	5	90
300/5	27	<3	25
300/6	33	<3	10
300/7	47	3	25
300/8	63	<3	10

# Site 2:

## Transect Data Traitors Cove 8

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
Ref Pt	1	5	90
150/1	4	31	100
150/2	5	<3	50
150/3	4	<3	75
150/4	4	<3	75
150/5	4	<3	75
150/6	4	<3	75
150/7	4	<3	50
150/8	3	3	75
150/9	3	3	90
150/10	3	3	100
150/11	2	5	100
150/12	2	5	100
150/13	2	5	100
150/14	3	10	100
150/15	4	10	100
150/16	7	5	100
150/17	11	<3	10
180/1	4	8	100
180/2	4	<3	50
180/3	4	<3	75
180/4	6	<3	10
180/5	11	<3	75
180/6	16	<3	75
180/7	19	<3	75
180/8	23	<3	75
180/9	26	<3	75
180/10	31	15	100
180/11	35	13	100
180/12	38	10	100
180/13	40	5	100
180/14	43	5	90
180/15	45	3	75
180/16	48	<3	50

## Transect data (cont.)

## Traitors Cove 8

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
210/1	4	15	100
210/2	5	5	100
210/3	11	<3	10
210/4	18	<3	10
210/5	26	5	100
210/6	33	10	100
210/7	38	13	100
210/8	41	8	90
210/9	45	8	90
210/10	48	8	90
210/11	48	5	75
210/12	49	3	50
240/1	4	3	50
240/2	5	8	100
240/3	10	<3	10
240/4	16	<3	10
240/5	23	10	100
240/6	30	13	100
240/7	35	13	100
240/8	42	5	90
240/9	45	3	75
240/10	47	<3	50
240/11	49	<3	50
240/12	50	<3	50
240/13	50	<3	50
270/1	3	5	90
270/2	5	10	100
270/3	7	3	75
270/4	8	<3	50
270/5	8	<3	25
270/6	9	5	100
270/7	10	3	75
270/8	12	3	75
270/9	13	3	75
270/10	14	5	90
270/11	16	5	90

## Transect data (cont.)

## Traitors Cove 8

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
270/12	17	10	100
270/13	19	8	100
270/14	22	8	100
270/15	22	3	90
270/16	20	5	90
270/17	24	3	90
270/18	28	<3	75
270/19	32	<3	50
270/20	36	<3	25



## Site 3:

Transect Data  
Carroll Inlet 20

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
Ref Pt	0	<3	10
350/1	5	5	50
350/2	10	10	50
350/3	16	5	75
350/4	27	8	100
350/5	29	8	90
350/6	36	3	25
350/7	59	<3	10
020/1	6	5	50
020/2	17	56	100
020/3	30	25	90
020/4	46	25	90
020/5	61	<3	25
050/1	8	5	50
050/2	17	13	100
050/3	28	13	100
050/4	42	13	100
050/5	57	13	100
080/1	5	<3	25
080/2	8	8	100
080/3	18	15	100
080/4	22	15	100
080/5	27	15	100
080/6	32	8	100
080/7	36	8	100
080/8	45	18	100
080/9	59	3	25
110/1	6	3	75
110/2	9	8	100
110/3	13	10	100
110/4	18	8	100
110/5	20	3	75
110/6	23	5	90
110/7	30	8	100

Transect data (cont.)

Carroll Inlet 20

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
110/8	33	8	100
110/9	40	8	100
110/10	49	3	75
110/11	60	3	50

## Site 4:

Transect Data  
Davidson Inlet 8

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
Ref Pt	5	<3	10
290/1	16	8	100
290/2	17	5	100
290/3	19	5	100
290/4	22	10	100
290/5	24	8	100
290/6	25	5	100
290/7	26	5	100
290/8	26	5	100
290/9	27	5	100
290/10	28	5	100
290/11	29	5	100
290/12	29	5	100
290/13	28	5	100
290/14	26	5	100
290/15	24	3	100
290/16	20	3	90
290/17	18	<3	25
290/18	18	<3	50
320/1	15	10	100
320/2	18	15	100
320/3	24	8	100
320/4	26	5	100
320/5	31	8	100
320/6	31	5	100
320/7	32	5	100
320/8	35	5	100
320/9	35	5	100
320/10	36	5	100
320/11	36	5	100
320/12	35	5	100
320/13	35	5	100
320/14	36	5	100
320/15	37	3	90
320/16	36	3	90

# Transect data (cont.)

## Davidson Inlet 8

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
320/17	36	<3	75
320/18	38	<3	50
350/1	14	20	100
350/2	17	15	100
350/3	19	10	100
350/4	22	8	100
350/5	23	5	100
350/6	26	5	100
350/7	27	5	100
350/8	29	3	100
350/9	28	3	100
350/10	31	5	100
350/11	31	5	100
350/12	33	5	100
350/13	35	5	100
350/14	36	5	100
350/15	37	5	100
350/16	37	5	100
350/17	38	5	100
350/18	38	5	100
350/19	38	3	100
350/20	39	3	90
350/21	38	<3	50
020/1	12	10	100
020/2	16	8	100
020/3	17	8	100
020/4	17	8	100
020/5	18	5	100
020/6	19	5	100
020/7	19	5	100
020/8	22	5	100
020/9	24	5	100
020/10	25	5	100
020/11	25	3	100
020/12	27	5	100
020/13	28	3	90
020/14	30	3	90

## Transect data (cont.)

## Davidson Inlet 8

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
020/15	32	<3	75
020/16	33	<3	75
050/1	14	10	100
050/2	15	8	100
050/3	16	5	100
050/4	16	5	100
050/5	17	5	100
050/6	18	5	100
050/7	18	5	100
050/8	17	5	100
050/9	17	5	100
050/10	17	3	100
050/11	17	3	100
050/12	17	3	100
050/13	17	3	100
050/14	18	3	100
050/15	19	3	90
050/16	18	3	90
050/17	19	<3	75
050/18	19	<3	75

# Site 5:

## Transect Data Twelve Mile Arm 1

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
Ref Pt	16	25	100
340/1	19	23	100
340/2	22	13	100
340/3	24	13	100
340/4	27	15	100
340/5	31	13	100
340/6	34	8	100
340/7	39	3	90
340/8	45	3	90
340/9	49	3	90
340/10	52	3	90
340/11	57	<3	75
340/12	61	<3	50
310/1	19	28	100
310/2	23	20	100
310/3	28	18	100
310/4	34	10	100
310/5	39	8	100
310/6	43	5	100
310/7	48	3	90
310/8	55	<3	50
310/9	61	<3	25
280/1	21	20	100
280/2	28	8	100
280/3	35	3	90
280/4	40	0	<10
280/5	58	<3	25
280/6	62	<3	25
250/1	20	13	100
250/2	27	5	100
250/3	35	5	90
250/4	43	5	90
250/5	56	<3	50
250/6	63	<3	50

## Transect data (cont.)

## Twelve Mile Arm 1

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
220/1	17	18	100
220/2	19	10	100
220/3	26	5	100
220/4	29	5	100
220/5	36	3	90
220/6	41	3	90
220/7	46	3	90
220/8	50	<3	90
220/9	57	<3	50

# Site 6:

## Transect Data Ulloa Channel 4

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
Ref Pt	3	0	<10
055/1	8	0	10
055/2	21	<3	10
055/3	26	13	100
055/4	29	8	100
055/5	32	3	90
055/6	35	<3	50
055/7	39	<3	50
055/8	42	<3	50
055/9	45	<3	50
055/10	48	<3	50
055/11	53	<3	50
055/12	55	<3	50
085/1	9	<3	10
085/2	20	8	90
085/3	27	10	100
085/4	31	5	100
085/5	35	3	90
085/6	39	<3	75
085/7	42	<3	50
085/8	45	<3	50
085/9	50	<3	50
085/10	52	<3	25
085/11	53	<3	25
085/12	55	<3	10
115/1	11	15	100
115/2	21	15	100
115/3	30	18	100
115/4	33	13	100
115/5	35	8	100
115/6	38	5	100
115/7	40	3	75
115/8	40	<3	50
115/9	40	<3	50



## Transect data (cont.)

## Ulloa Channel 4

Transect/ Sample Pt.	Depth from MLLW	Debris Depth (cm)	Percent Coverage
115/10	40	<3	50
115/11	40	<3	25
115/12	38	<3	25
145/1	9	3	100
145/2	18	10	75
145/3	27	<3	25
145/4	32	8	100
145/5	33	5	100
145/6	34	3	90
145/7	35	<3	50
145/8	34	<3	50
145/9	33	<3	25
145/10	31	<3	25
175/1	6	<3	75
175/2	11	3	75
175/3	18	<3	25
175/4	27	13	100
175/5	28	5	100
175/6	29	3	100
175/7	29	<3	50
175/8	28	<3	25
175/9	27	<3	10
175/10	27	<3	10

## D. Photo Key:

Photographs begin numbering from top left, reading to the right. The bottom right photograph is #4 (#8 on the back side of the page).

### Site 1:

#### Photograph Key

#### Thorne Arm 6

Photo #	Transect-Sample Pt.	Description
1	By Ref Pt	Base of bulkhead log - Shipworms
2	Ref Pt	Gravel, some debris w/ bacteria
3	240/1	Sunken log w/ decay products
4	240/2	Slight debris, cable and kelp
5	240/3	Short ledge on wall w/ some debris
6	Near 240	Example of rich life on wall
7	270/2	White Sea cucumber casts from decay
8	Near 270	Cable and wire on debris
9	300/1	Large & small debris, branch
10	Near 300	Wood chunks & log, cable
11	End of 240	Base of wall (105'), debris, hawser

## Site 2:

## Photograph Key

## Traitors Cove 8

Photo #	Transect-Sample Pt.	Description
1	Ref Pt	Edge of fill rock, start of debris
2	Ref Pt	Banding wire, white bacteria spots
3	Near Ref Pt	White decay products from log
4	210/1	Leaves, rock protruding
5	210/2	Leaves, small debris near edge
6	210/3	Sand, shell of initial slope
7	210/5	Zone of small, uniform debris
8	210/6	Debris still uniformly sized
9	210/7	Leaves on the debris
10	210/8	Substrate now visible
11	210/9	Old survey stake
12	210/11	Less surface debris (over humus?)
13	180/16	No surface debris (bark in silt?)
14	180/13	Dungeness crab, creek debris

## Site 3:

### Photograph Key

#### Carroll Inlet 20

Photo #	Transect-Sample Pt.	Description
1	Surface	Surface view of bulkhead
2	Ref Pt	Location at bottom bulkhead log
3	020/1	Debris filling in fill rock crevices
4	020/2	Deeper debris accumulation
5	020/3	Debris accumulation in pockets
6	Near 020	Example of thick encrusting life
7	350/4	Small, white flatfish (top center)
8	110/4	Cable coil, 2 Moon snail egg cases
9	110/5	Nudibranch w/ fine debris on back
10	110/6	Juvenile Sea Pens
11	110/10	Pennant over thin debris & rocks
12	050/2	Camouflaged Painted Greenling

## Site 4:

## Photograph Key

## Davidson Inlet 8

Photo #	Transect-Sample Pt.	Description
1	Surface	View of low angle slide
2	Ref Pt	Kelp, clam siphon skin, little debris
3	290/1	Bark debris chips and chunks
4	290/2	Debris w/ silt covering
5	290/3	Less silt over debris
6	290/4	Smaller bark debris
7	290/5	Larger bark chips
8	290/6	Den cone of burrowing crustacean
9	290/17	Kelp, little debris visible
10	350/2	Bark debris, some detrital kelp
11	350/3	Debris w/ bacterial areas
12	350/6	Old wire, thin surface debris layer
13	350/7	Old survey stake
14	350/11	Old rope, juvenile Sea cucumber
15	350/21	More silt, less visible debris
16	Near 020	Coring tube w/ inconclusive results

## Site 5:

### Photograph Key

#### Twelve Mile Arm 1

Photo #	Transect-Sample Pt.	Description
1	Surface	View of bulkhead and A-frame
2	Ref Pt	At base of center slide log
3	Ref Pt	Slide log broken 3 ft above bottom
4	340/1	Complete debris coverage
5	340/2	100% cover but different character
6	340/3	Nudibranch, Sea star by log
7	Near 340/3	Snail moving about on debris
8	340/4	Varied debris sizes
9	340/5	More uniform debris size
10	340/6	Sea cucumber, shells visible now
11	340/9	Substrate visible
12	220/2	Sea cucumber and casts on debris
13	Near 220/3	Probable Octopus den
14	220/5	Debris w/ rock/sand protruding
15	220/6	Mussel shell from boomsticks
16	Near 220/9	Old survey stake

## Site 6:

## Photograph Key

## Ulloa Channel 4

Photo #	Transect-Sample Pt.	Description
1	Surface	View of low angle slide
2	Ref Pt	Diatoms rubbed off by boat
3	085/1	Bark chips amongst fill rocks
4	085/2	Larger bark pieces covering rocks
5	Near 085/3	Juvenile King crabs on log
6	085/3	100% debris cover, wire
7	085/4	Some silt, diatoms on debris
8	085/5	Debris over visible substrate
9	085/6	More substrate visible
10	085/9	Sun star and cable
11	085/9 area	Boulder and track anchor
12	085 area	Nudibranch egg masses
13	115/1	Bark chips on slope
14	175/3	Typical life on southern fill rocks